US-PAT-NO: 5528222
DOCUMENT-IDENTIFIER: US 5528222 A
TITLE: Radio frequency circuit and memory in thin flexible package

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Abstract Text - ABTX (1):

A novel thin and flexible radio frequency (RF) tag has a semiconductor circuit with logic, memory, and a radio frequency circuits, connected to an antenna with all interconnections placed on a single plane of wiring without crossovers. The elements of the package (substrate, antenna, and laminated covers) are flexible. The elements of the package are all thin. The tag is thin and flexible, enabling a unique range of applications including: RF ID tagging of credit cards, passports, admission tickets, and postage stamps.

US Patent No. - PN (1):

5528222

Application Filing Date - AD (1):

19940909

TITLE - TI (1):

Radio frequency circuit and memory in thin flexible package

Brief Summary Text - BSTX (9):

Tags exist that have the-length and width of a standard credit card. However, these cards typically are over 2.5 mm thick and have a non-flexible casing. Tags also exist that have a credit card size length and width but with bumps where circuit is placed that causes them to be too thick to fit in card reader machinery

Brief Summary Text - BSTX (15):

Prior art teaches that there is a long felt need to manufacture thin RF ID tags on flexible substrates. However, while the goal of a thin flexible tag is desired, the prior art has failed to reach the goal. One prior art reference discloses a tag that is 1.5 to 2.0 mm thick. This tag thickness limits the applications of this tag. For example, it is far thicker than the International Organization for Standardization (ISO) standard credit card thickness of 0.76 mm and therefore could not be used in a credit card to be inserted into a credit card reader.

Brief Summary Text - BSTX (17):

Another prior art reference discloses a package with a total thickness of 0.8 mm. This is still greater than the ISO standard credit card thickness of 0.76 mm. Furthermore, while thin elements are disclosed, no care is taken to use flexible materials throughout. The components are mounted on a hard circuit card and encapsulated in plastic. (Hard means can not be torn easily by hand.) The result a is rigid package. The prior art has not shown the use of thin flexible laminate covering materials for the packages. The results are that the packages are thick, and inflexible.

Brief Summary Text - BSTX (21):

An object of the invention is a flexible radio frequency tag apparatus that may fit within the thickness limit of an ISO standard credit card, a passport cover, a postage stamp, an anti-theft device, or an admission ticket.

Brief Summary Text - BSTX (23):

The present invention is a novel radio frequency (RF) tag that comprises a semiconductor circuit that has logic, memory, and radio frequency circuits. The semiconductor is mounted on a substrate and is capable of receiving a RF signal through an antenna that is electrically connected to the semiconductor through connections on the semiconductor. The present invention is a novel structure of a radio frequency tag design that is thin and flexible. The tag has the antenna and all interconnections placed on a single plane of wiring without crossovers. The elements of the package are placed adjacent to one another, i.e., they are not stacked. Elements of the package, the substrate, antenna, and laminated covers, are flexible. The elements are all thin such that the total package thickness including covers does not exceed that of an ISO standard **credit card**. The resulting tag package, comprised of thin, flexible components arranged and connected in a novel way, is also thin and flexible. Accordingly, this enables a novel range of applications that include: RF ID tagging of **credit cards,** passports, admission tickets, and postage stamps.

Drawing Description Text - DRTX (14):

FIG. 12 shows a thin tag placed inside a **credit card**.

Detailed Description Text - DETX (25):

FIG. 12 shows ISO standard **credit card** 1210 containing an RF tag 1220. The **credit card** may serve as an ATM card, frequent flyer card, library card, phone card, employee ID, medical ID **card, gasoline credit card or any credit or debit card**. The covers (laminates 270, 370) of the tag could be the covers of the **credit card,** preferably PVC laminations. The core of the **credit card,** 0.5 mm thick, has a window placed in it at the time of manufacture. The 0.5 mm thick tag package is placed in the window and then sealed into the card. The resulting **credit card,** including the tag, will not only have the length and width that meet the ISO standard, but the thickness as well.

Claims Text - CLTX (21):

17. A circuit, as in claim 16, that is encapsulated as an International Organization for Standardization (ISO) standard **credit card** size package.

EXAMINER'S SEARCH NOTES

US005528222A

United States Patent [19]

Moskowitz et al.

[11] Patent Number: 5,528,222

[45] Date of Patent: Jun. 18, 1996

[54] **RADIO FREQUENCY CIRCUIT AND MEMORY IN THIN FLEXIBLE PACKAGE**

[75] Inventors: **Paul A. Moskowitz**, Yorktown Heights; **Michael J. Brady**, Brewster; **Paul W. Coteus**, Yorktown Heights, all of N.Y.

[73] Assignee: **International Business Machines Corporation**, Armonk, N.Y.

[21] Appl. No.: **303,977**

[22] Filed: **Sep. 9, 1994**

[51] **Int. Cl.**[6] **H04Q 1/02**

[52] **U.S. Cl.** **340/572**; 29/825; 29/829; 29/836; 340/825.3; 340/825.34; 340/825.54

[58] **Field of Search** 340/572, 825.34, 340/825.3, 825.54; 29/836, 829, 825

[56] **References Cited**

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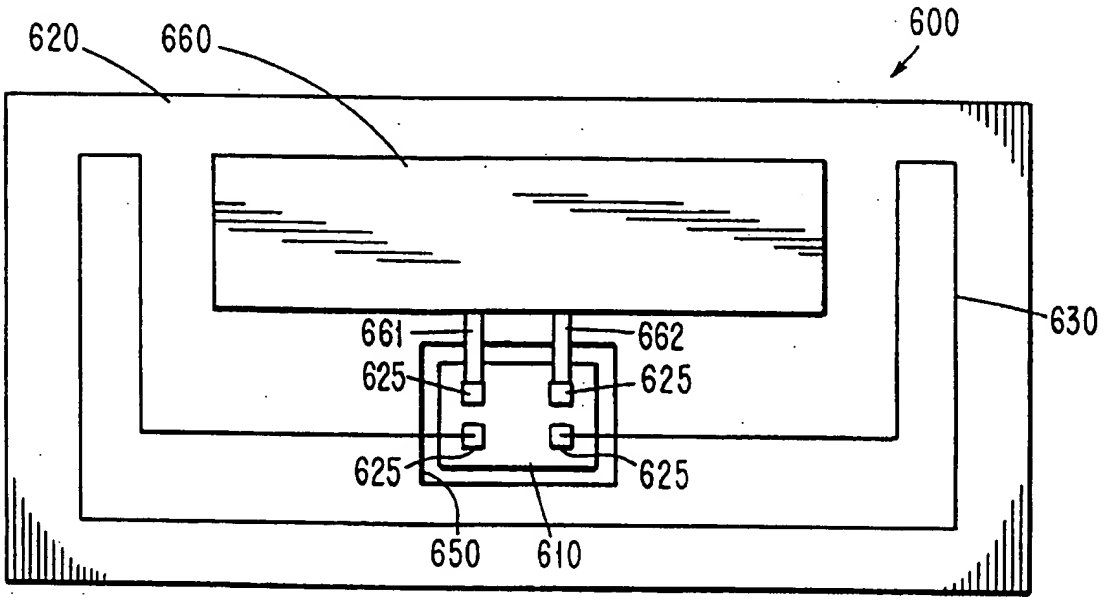
R. R. Tumalla et al, "Microelectronics Packaging Handbook", 1989, pp. 68, 76, 1154.

Primary Examiner—Glen Swann
Attorney, Agent, or Firm—Louis J. Percello

[57] **ABSTRACT**

A novel thin and flexible radio frequency (RF) tag has a semiconductor circuit with logic, memory, and a radio frequency circuits, connected to an antenna with all interconnections placed on a single plane of wiring without crossovers. The elements of the package (substrate, antenna, and laminated covers) are flexible. The elements of the package are all thin. The tag is thin and flexible, enabling a unique range of applications including: RF ID tagging of credit cards, passports, admission tickets, and postage stamps.

29 Claims, 10 Drawing Sheets



EXAMINER'S SEARCH NOTES

US005484997A

United States Patent [19]

Haynes

[11] Patent Number: 5,484,997

[45] Date of Patent: Jan. 16, 1996

[54] **IDENTIFICATION CARD WITH RF DOWNLINK CAPABILITY**

[76] Inventor: **George W. Haynes**, 101 Summit Blvd., Englewood, Colo. 80110

[21] Appl. No.: **251,637**

[22] Filed: **May 31, 1994**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 162,759, Dec. 7, 1993, abandoned.

[51] **Int. Cl.**[6] **G06K 16/06**; G07B 15/02

[52] **U.S. Cl.** **235/492**; 235/384

[58] **Field of Search** 235/487, 491, 235/492, 380, 375, 384, 385

[56] **References Cited**

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4,701,601	10/1987	Francini et al.	235/449
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Guillermo Gonzalez, "Microwave Transistor Amplifiers; Analysis and Design", Prentice Hall, Mar. 1984, pp. 194–214.

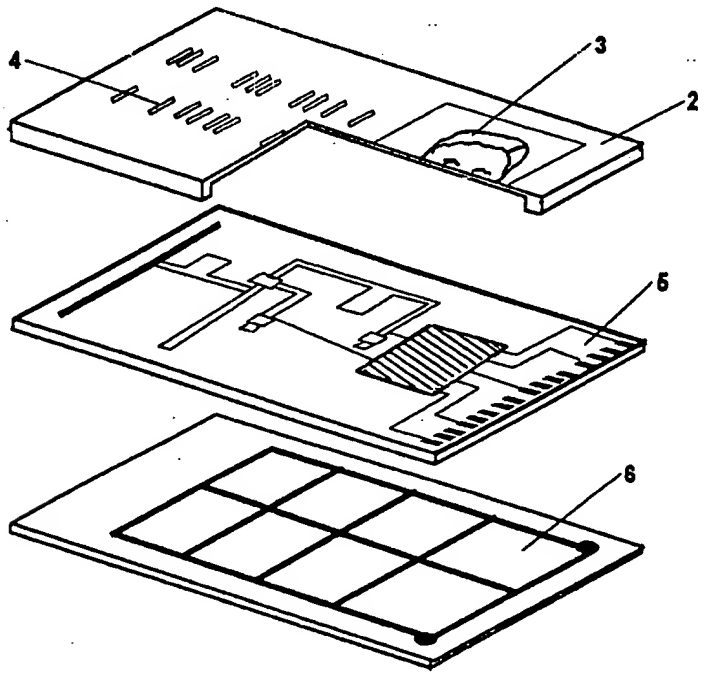
Primary Examiner—Donald T. Hajec

Assistant Examiner—Thien Minh Le

[57] **ABSTRACT**

An Integrated Circuit (IC) card is powered by an array of photovoltaic cells with an Electrically Erasable Programmable Read Only Memory (EEPROM) with associated electronic to read the EEPROM and generate a serial bit stream that modulates a Frequency Shift Keying (FSK) RF system employing a Dielectric Resonant Oscillator (DRO) and a matched dipole antenna. The IC card is totally passive and derives its energy from an external source of radiant energy upon the array of photovoltaic cells resident in the IC card. The IC card is capable of remote interrogation which enables the IC card to be used for traffic and personnel monitoring as well as credit card applications.

2 Claims, 2 Drawing Sheets



US-PAT-NO: 5484997
DOCUMENT-IDENTIFIER: US 5484997 A
TITLE: Identification card with RF downlink capability

Abstract Text - ABTX (1):

An Integrated Circuit (IC) card is powered by an array of photovoltaic cells with an Electrically Erasable Programmable Read Only Memory (EEPROM) with associated electronic to read the EEPROM and generate a serial bit stream that modulates a Frequency Shift Keying (FSK) RF system employing a Dielectric Resonant Oscillator (DRO) and a matched dipole antenna. The IC card is totally passive and derives its energy from an external source of radiant energy upon the array of photovoltaic cells resident in the IC card. The IC card is capable of remote interrogation which enables the IC card to be used for traffic and personnel monitoring as well as credit card applications.

US Patent No. - PN (1):

5484997

Application Filing Date - AD (1):

19940531

TITLE - TI (1):

Identification card with RF downlink capability

Brief Summary Text - BSTX (10):

The backbone of credit card communication is the magnetic stripe which is scanned by appropriate readers within remote terminals for the verification of transactions or the delivery of cash. The advantage of the magnetic stripe is that it is an entirely passive device with a non-volatile memory. The disadvantages are that it requires manual insertion into a reading device and that the amount of static information which can be stored is limited. One obvious way to limit credit card fraud is to increase the amount of personal data such as fingerprints and portraits contained within each credit card; this, however, is far beyond the capabilities of the magnetic stripe.

Brief Summary Text - BSTX (11):

The requirement for increased data capability implies the need for a smart-card or integrated circuit (IC) card with its attendant memory capability. However, the Credit Card Industry has been slow to adopt IC cards due to their inherent problems. Such cards are often unreliable, due largely to the need for metallic contacts to couple the card to a card reader. The contacts are readily tarnished, have a short useful life and require a precision card reading mechanism.

Brief Summary Text - BSTX (12):

A solution to this problem is proposed in U.S. Pat. Nos. 4,701,601 (Francini) and 4,791,283 (Burkhardt) wherein the identification data is transfered from the IC card by using magnetic stripe emulators. This prior art increases the storage capability of the credit card, but does not improve the communication of the credit card with the terminal. Other solutions involving communication via magnetic induction are proposed in U.S. Pat. Nos. 4,650,981 (Foletta) and 4,960,983 (Takesi).

Brief Summary Text - BSTX (15):

These approaches require a battery powered **credit card** which diminishes its utility. **Credit cards** and other identification cards need to be totally passive which is why they are so useful, whereas IC cards are usually battery powered. To solve the power problem, some passive transponders, for example, have been used in various automatic identification schemes for vehicles such as automobiles and railroad cars. These have applications for monitoring the location of freight cars and the automatic collection of toll fees for vehicular traffic on a nonintrusive basis.

Brief Summary Text - BSTX (17):

These approaches to energizing passive responders have serious shortcomings when applied to electronics embedded in small plastic **cards as exemplified by credit cards,** driver licences, identification badges and IC cards in general. The size of the conductors is constrained by the size of the plastic card which in turn limits the induced voltages and therefore the power to drive the responder. In these cases, a more directed form of energy is required for passive responders on a smart card and this can be provided by a directed beam of radiant energy onto a large array of photovoltaic cells covering the card. For nonintrusive interrogation, especially at night, infrared illumination may be used. U.S. Pat. No. 4,575,621 (Dreifus) uses optical coupling for both communication and energy transfer to a portable electronic transaction device to avoid mechanical contact problems. But this is performed within the confines of a terminal slot and does not permit remote interrogation. Furthermore, the portable electronic transaction device contains a battery which limits the usefulness of the disclosure since **credit cards** should, of necessity, be totally passive. In U.S. Pat. No. 4,916,296, which is conceptually similar to Dreifus' disclosure, Streck advocates the use of solar cells to provide energy, but confines his disclosure to optical(infra-red) communication which appears simpler than RF communication. However, simple on-card RF communication is possible by using Dielectric Resonant Oscillators (DRO) which are based on the instability of some transistor amplifier configurations.

Brief Summary Text - BSTX (25):

It is an objective of this invention to provide an IC card that is capable of a multiplicity of uses including **credit cards,** driver licences and other identification cards such as social security cards and passports.

Detailed Description Text - DETX (3):

The IC card is an electronic device whose components are encapsulated in a plastic body in the form of a flat card, similar to a conventional **credit card**. Since the card does not have to be inserted into a slot to be read, its physical dimensions do not necessarily have to conform to the standard **credit card** size. For passport applications, the card can be larger to include a standard passport photograph 3 as illustrated in FIG. 1. Other embossed data 4 may be included on the front face of the card and this will be determined by the various transactions and functions the card has to perform. The electronics layer 5 contains a Dielectric Resonant Oscillator circuit 7, a digital circuit 22 and a matched dipole 20. The third layer contains the photovoltaic cells 6 that power the system.

Detailed Description Text - DETX (7):

The IC card driven by photovoltaic cells has limited power. For a conventionally sized **credit card** illuminated by solar power, the available power is slightly less than half a watt. This constrains the degree of sophistication that can be incorporated into the IC card. The sophistication therefore has to be built into the interrogation terminals which will have the power resources and processing capabilities necessary to perform them. This sophistication is required in two basic areas. The RF circuit 7 (FIG. 3) contains a Dielectric Resonator Oscillator DRO that is used to generate the high frequency signals for the FSK modulated carrier. The limited power resource dictates a crude DRO devoid of any frequency stabilization as illustrated in FIG. 2. Furthermore, the signal modulation is limited to FSK, since the power is not available to drive the additional FETs required for phase shift keying(PSK) modulation. Minor fluctuations within the two primary frequencies of the FSK modulation and frequency transients induced by the frequency switching have to be compensated for in the interrogation terminal. Similarly, the digital circuit 22 (FIG. 4) has a 10 MHz clock that is generated by an astable ring oscillator, thus avoiding a crystal, which can be constructed within an integrated circuit and minimizes the thickness of the

IC card. Once again the interrogation terminal has to determine the fluctuation in bit rate to maintain lock on the data stream.

Detailed Description Text - DETX (11):

As a rule the IC card would be confined to a wallet or purse until it is retrieved for use, as is the custom for **credit cards,** which limits the indiscriminate transmission of data. However, for traffic monitoring, the drivers licence or equivalent card can be inserted into a fixture that is positioned at a convenient corner of a window so that it does not obscure the driver's vision, yet is visible to traffic monitors. The terminal for such applications can be handheld guns to direct the beams of radiant energy on selected traffic. To avoid interfering with the driver's ability, the radiant beam of energy can be infra-red or the IC card can be mounted at some unobtrusive place such as the rear window of the vehicle. The associated electronics and display can be packaged within the gun or resident within patrol cars or traffic stations. Since the transmitted energy is less that 20 dBm (100 mW), the energy intensity at an interrogation distance of 10 meters is -51 dBm/sq.cm. (7.96 10.sup.-6 mw/sq.cm.) so that a small dish antenna is required to capture the signal. With traffic monitoring it is possible to have a multiplicity of signals being transmitted due to activation of the IC cards by direct sunlight. In this case the signals can be separated by the beamwidth of the small dish antenna. If there is more than one vehicle in the line of sight, the space loss of the further vehicle will preclude it from being detected.